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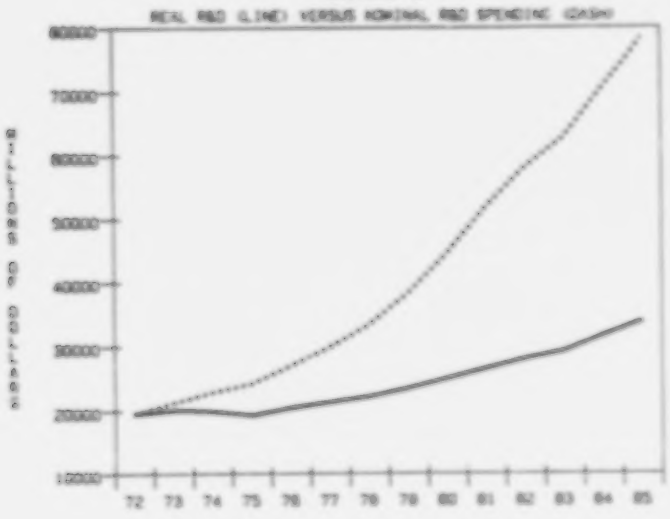
30th ANNUAL McGRAW-HILL SURVEY OF BUSINESS' PLANS FOR RESEARCH AND DEVELOPMENT EXPENDITURES, 1985-88

The economic recovery waited until 1984 to strike life into research and development (R&D) spending by American industry, but when it did, it struck in a big way.

After 1983's rather unambitious 8.3% gain (compared to R&D's 12% annual growth rate over the past decade) 1984 U.S. industry outlays on research and development are estimated to have jumped 12.3%. And even if that figure doesn't seem so spectacular considering R&D growth in the past ten years (Table V), consider this: Due to the extreme pressure cheaper imports put on U.S. markets, there was little price inflation last year. Hence, 1984's R&D expenditure growth was practically all real--quite spectacular indeed compared to average annual real growth of only about 3.7% from 1972 to 1983. (See Chart 1.) And if 1985 R&D spending plans pan out, then the current year looks pretty good too.

According to McGraw-Hill's latest survey of R&D spending plans by U.S. business, expenditures in 1985 are slated to rise 10.9% (Table I). While the dollar increase planned by industry is weaker than that of some previous years, stunted price inflation (or even declining prices, thanks to imports) will mean strong real growth.

CHART I

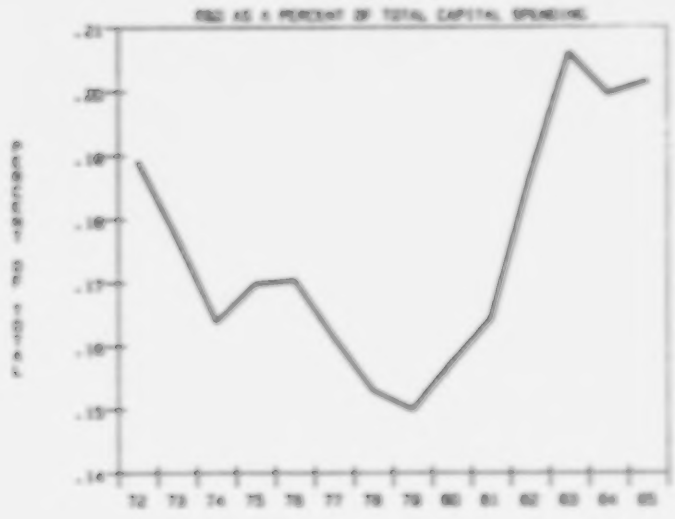


R&D May Still Be Weak Compared to Capital Spending by Manufacturers

Projected 1985 R&D spending is also strong compared to business's total planned capital spending this year: R&D expenditure growth should outpace that of capital spending by about one percentage point. (See Chart 2.) Capital spending by manufacturing industries, however, is projected to outpace R&D spending substantially in 1985 (17.5% versus R&D's projected 11.1%). This may reflect manufacturers' putting into effect last year's R&D spending results.

In certain industries where the "high-tech" edge is crucial to market survival--instruments and nonelectrical machinery (which includes computers), for example--R&D spending increases fall far below the planned growth in plant and equipment expenditures. That may mean some firms are more concerned with the short term rather than the long--hence, forsaking future product

CHART 2



enhancement for current production capacity and efficiency. Despite R&D's weaker growth rate, however, the instruments and nonelectrical machinery industries are still spending over $4 billion and $8 billion respectively on R&D--no mean amounts. Whatever the case, one thing is clear: Through the strength in their R&D plans, American manufacturers remain committed to the battle with foreign companies--and each other.

Other indicators of R&D strength abound. For example, R&D spending as a percentage of sales at 3.02% in 1984 was at its highest point in history. (See Tables III & VII.) In fact, if this year follows the survey's prediction, 1985's figure should beat even that. The huge leap in R&D as a percentage of sales in primary metals fueled much of the overall increase, but instrument producers also upped R&D as a percentage of sales substantially.

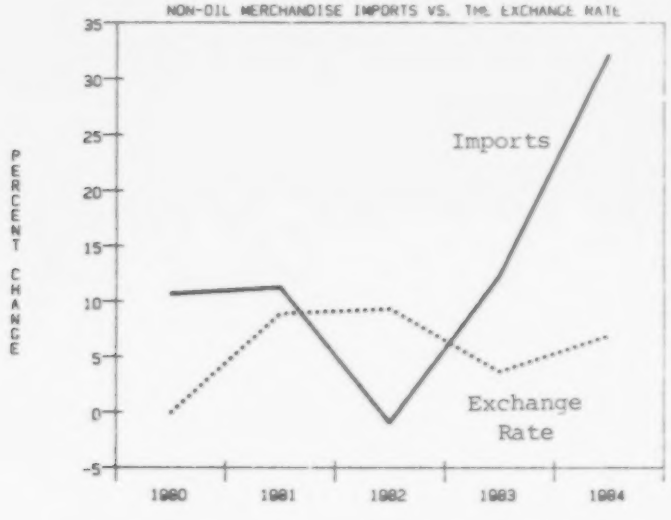
Strong Dollar May Harm Firms

Trying to Cash in on R&D Surge

But while the businesses surveyed expected to maintain healthy R&D expenditures, just where the funds will be spent is a matter of great concern to R&D equipment suppliers. With sharp cost cutting necessary to compete with foreign producers, U.S. industry went shopping for their R&D needs at the supplier with the best price. As a result, imports of all types of electronics and instruments were up sharply during the last two years while export increases were rather sluggish.

The major culprit behind foreign product import penetration is the high-interest-rate-backed U.S. dollar. (See Chart 3.) But even as the economy weakens and interest rates decline, the long lag between exchange rate changes and trade movements will postpone any significant improvement in

CHART 3



domestic industry trade prospects until 1986--assuming, that is, that the dollar does decline significantly at all in the short term. Furthermore, even if the dollar does decline the 25-30% needed to get it back to historical

levels, there's little hope that producers from abroad will give up their newly-bloated U.S. market share without a fight.

There is one positive aspect to the import blitz. The same imports that are squeezing American industry margins are helping to spur the latest surge in R&D spending. The most prominent example lies in the spending plans of primary metals producers--the industry that plans the largest percentage increase in outlays for R&D. As cheaper metals from abroad make U.S. primary metals manufacturers smolder, their R&D plans indicate that a new round of competition is about to begin. In 1985, iron and steel and nonferrous metals producers plan to boost R&D spending some 25% and 29% respectively. Looking ahead through 1988, primary metals companies intend to continue boosting R&D spending over and above most other industries. In particular, nonferrous metals producers said they were going to increase such spending almost 50% from 1985 to 1988--the most ambitious plan by American industry according to the survey. Unfortunately, it may be too late for some metal producers to get the financing needed for expenditure increases of this magnitude since industry profits prospects are none too good.

Not surprisingly, some of the other industries that lead the pack in planned R&D expenditure increases over the next few years are also severely impacted by recent import penetration. They include communication equipment, farm equipment, and engineering instruments (Table II).

After giddying growth throughout 1983 and 1984, it is little wonder that motor vehicle manufacturers have the bucks to boost R&D spending a projected 21.3% in 1985. And with the Japanese sure to capitalize on the newly lifted "voluntary" import restrictions, beefed up R&D spending by U.S. auto manufacturers is imperative for future survival. Evidence outside the survey bolsters the finding that the auto industry has embarked on an ambitious R&D plan. For example, one auto company has reported developing a

computer-aided-design tool with graphics sophisticated and detailed enough to eventually cut out some of the costly physical model construction associated with the conception and birth of a new vehicle.

In the computer industry, not only are companies planning to increase R&D spending by 11.4% in 1985, the spending itself is taking a new turn. Industry analysts estimate that over 50% of computer company R&D spending is now being concentrated on software rather than hardware. There is an added plus in this development as well: As more and more of the computer's capability comes from software rather than the machine itself, domestic producers become less vulnerable to the cost advantage of foreign producers.

R&D plans in the aerospace industry are somewhat weak compared to earlier rates of increase, but "Star Wars" enthusiasts can take heart. Even though the aerospace industry plans only 9.4% growth in R&D expenditures in 1985 (R&D outlays on aircraft and missiles have grown at an annual rate exceeding 14% from 1980 to 1983), the Reagan administration's fiscal 1986 budget contains a 22% increase in defense-related R&D.

What's Ahead in the Long Term

In the longer term (1985-1988), some of the industries that expect their R&D spending to exceed the 21.3% planned by business overall include primary metals, instruments (always a big R&D spender), rubber and plastics, and electrical machinery. On the downside, the companies that will increase their spending less than the norm in the extended outlook will probably be in the motor vehicle, fabricated metals, and food and beverage industries. With the exception of motor vehicle manufacturers who just came off a period of high R&D outlays, these industries don't rely on a high-tech orientation to help

sales, so the implications of reduced R&D spending growth here shouldn't be too serious for U.S. competitiveness.

What may hold serious implications for U.S. industry, however, is the overall outlook for R&D spending in the coming years. In the 1985 survey, all business said it expected to raise R&D expenditures 21.3% from 1985 through 1988. This figure is down substantially from last year's 27.2% three-year projection. Additionally, compared to the 12.2% annual growth rate of total industrial R&D spending during the first half of the 1980s, the 6.6% annual growth rate predicted by the survey for the next three years is down sharply. One consolation may be that R&D expenditures projected by the survey three years out often understate the growth that actually occurs.

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NOTE: The other manufacturing category in the tables includes lumber, wood products and furniture, tobacco, printing and publishing, leather, jewelry, toys, and transportation equipment other than autos, trucks nd parts and aerospace. The nonmanufacturing category includes mining, construction, electric and gas utilities, commercial enterprises and transportation.

SOURCES: National Science Foundation, McGraw-Hill Economics Department

TABLE I

RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of Dollars)

INDUSTRY	1983 ESTIMATED	1984 ESTIMATED	PLANNED		% CHANGE	
			1985	1988	1984-85	1985-88
Iron & Steel	658	619	774	982	25.0	26.9
Nonferrous Metals	438	623	801	1,187	28.6	48.2
Electrical Machinery	13,651	14,677	15,954	19,731	8.7	23.7
Non-Electrical Machinery	8,382	9,232	10,303	12,829	11.6	24.5
Autos,Trucks & Parts	5,372	6,469	7,845	8,867	21.3	13.0
Aerospace	13,741	16,685	18,255	21,680	9.4	18.8
Fabricated Metals	634	545	576	625	5.6	8.6
Instruments	4,387	6,001	6,708	9,209	11.8	37.3
Stone,Clay & Glass	628	705	775	930	10.0	20.0
Chemicals	7,287	7,337	8,066	9,688	9.9	20.1
Paper & Pulp	730	665	722	884	8.6	22.5
Rubber & Plastic	942	1,018	1,102	1,371	8.2	24.5
Petroleum	2,199	2,197	2,345	2,506	6.7	6.8
Food & Beverage	880	935	1,028	1,209	9.9	17.6
Textiles	188	170	176	213	3.2	21.2
Other Manufacturing	634	731	782	947	7.0	21.1
ALL MANUFACTURING	60,751	68,609	76,210	92,859	11.1	21.8
ALL NONMANUFACTURING	2,065	1,963	2,060	2,086	5.0	1.3
ALL BUSINESS	62,816	70,572	78,270	94,945	10.9	21.3

TABLE II

DETAILED INDUSTRY TREND DATA
(Millions of Dollars)

	RESEARCH AND DEVELOPMENT Spending Plans-% Change		
	1983-84	1984-85	1985-88
Furniture	32.4	15.3	40.8
Lumber	11.8	18.3	3.0
Tobacco	8.2	3.7	17.2
Printing and Publishing	0.0	0.0	0.0
Leather	33.3	33.0	33.0
Electric Utilities	-7.6	3.3	0.5
Gas Utilities	53.1	3.9	25.0
Electrical Industrial Apparatus	12.9	11.2	25.5
Household Appliances	16.1	1.9	11.8
Electric Lighting and Wiring	-15.1	-12.0	0.0
Communication Equipment	5.7	17.0	34.0
Other Electric Equipment	7.1	-3.1	10.4
Engines and Turbines	8.5	10.0	10.0
Farm Equipment	12.0	17.0	10.0
Construction, Mining, Materials Handling Eq.	1.7	5.2	14.8
Metalworking Machinery	17.4	7.5	22.0
Special Industry Machinery	25.3	8.1	13.9

TABLE II (Continued)

DETAILED INDUSTRY TREND DATA
(Millions of Dollars)

	RESEARCH AND DEVELOPMENT Spending Plans-% Change		
	1983-84	1984-85	1985-88
General Industrial Machinery	15.9	9.3	18.2
Office, Computing Machinery	13.7	11.4	27.1
Refrigeration and Service Industry Machinery	15.0	10.3	20.5
Engineering Instruments	1.6	14.8	11.3
Medical Instruments	74.7	8.9	23.0
Drugs	7.5	14.4	21.2
Industrial Chemicals	10.5	6.4	22.2
Other Chemicals	-53.5	2.5	7.6
Meat Products	-1.2	6.0	8.0
Dairy Products	3.2	12.0	33.0
Preserved Fruits and Vegetables	36.3	5.2	21.5
Grain Mill Products	15.7	1.2	3.5
Bakery Products	22.0	NC	NC
Sugar and Confectionary Products	-14.5	13.0	44.0
Fats and Oils	-5.1	5.0	15.0
Miscellaneous Plastics Products	0.5	0.1	0.2
Glass	10.3	5.0	15.0
Cement, hydraulic	11.1	4.3	11.4
Structural Clay Products	15.2	10.4	19.6
Concrete, Gypsum, Plaster	-20.0	50.0	50.0
Cutlery, Hand Tools, Hardware	5.3	-1.1	18.8
Plumbing and Heating Eq.	40.0	0.0	10.0
Fabricated Structural Metal	-41.4	5.0	5.1
Screw Machine Products	25.0	14.2	42.2

TABLE III

RESEARCH & DEVELOPMENT
AS A PERCENT OF SALES

INDUSTRY	1984	1985
Iron & Steel	1.15	1.31
Nonferrous Metals	1.00	1.23
Electrical Machinery	8.05	8.11
Non-Electrical Machinery	4.40	4.41
Autos,Trucks & Parts	3.36	3.84
Aerospace	21.73	19.59
Fabricated Metals	0.39	0.38
Instruments	11.22	11.55
Stone,Clay & Glass	1.28	1.30
Chemicals	3.46	3.56
Paper & Pulp	0.69	0.69
Rubber & Plastic	1.95	1.98
Petroleum	1.09	1.16
Food & Beverage	0.32	0.33
Textiles	0.31	0.30
Other Manufacturing	0.21	0.25
ALL MANUFACTURING	3.02	3.14

TABLE IV

RESEARCH & DEVELOPMENT
AS A PERCENT OF CAPITAL SPENDING

INDUSTRY	1984	1985
Iron & Steel	17.59	17.07
Nonferrous Metals	29.26	35.09
Electrical Machinery	100.87	109.92
Non-Electrical Machinery	60.11	54.80
Autos,Trucks & Parts	58.22	48.53
Aerospace	470.00	429.76
Fabricated Metals	15.94	14.18
Instruments	182.97	171.72
Stone,Clay & Glass	22.81	21.68
Chemicals	47.95	47.64
Paper & Pulp	9.29	9.50
Rubber & Plastic	32.83	32.15
Petroleum	8.62	7.85
Food & Beverage	10.63	9.68
Textiles	8.86	9.52
Other Manufacturing	4.40	3.85
ALL MANUFACTURING	49.57	46.85
ALL NONMANUFACTURING	3.40	3.27
ALL BUSINESS	19.96	20.15

TABLE V

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of Dollars)

INDUSTRY	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Primary Metals	$ 62	$ 69	$ 74	$ 90	$100	$131	$152	$177	$177	$171	$183
Iron & Steel	42	44	46	55	64	80	84	102	98	97	106
Nonferrous Metals	20	25	28	35	44	51	68	75	79	74	77
Machinery	330	358	455	543	669	781	930	949	901	914	958
Electrical Machinery & Communications	817	904	983	1,516	1,804	1,969	2,329	2,532	2,483	2,639	2,866
Radio & TV Receiving Equipment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Commun. Equip. & Elect. Components	74	141	200	575	748	868	1,162	1,324	1,404	1,591	1,773
Other Electrical Equipment	743*	763*	783*	941*	1,056*	1,101*	1,167*	1,208*	1,079*	1,048*	1,093*
Aerospace	829	999	1,285	2,138	2,574	2,609	3,090	3,514	3,829	4,042	4,712
Autos & Other Transp. Equipment	495	531	561	688	707	856	866	884	936	999	1,060
Fabricated Metal Products	52	55	65	116	135	162	138	145	136	146	153
Professional & Scientific Instrument	178	195	176	200	249	294	309	329	297	309	284
Scientific & Mechanical Measures	86	94	85	97	139	156	159	160	119	101	70
Optical, Surgical & Photo	92	101	91	103	110	138	150	169	178	208	214
Stone, Clay & Glass	40	45	46	60	69	75	81	88	88	96	100
Lumber & Furniture	10	10	10	10	14	12	12	10	10	10	11
Chemicals	374	407	445	641	705	792	891	980	1,101	1,175	1,239
Industrial Chemicals	269	289	315	460	503	553	600	666	706	738	809
Drugs & Medicines	40	50	60	94	104	128	154	162	180	195	216
Other Chemicals	65	68	70	87	98	111	137	152	215	242	214
Paper	29	33	32	36	35	42	49	56	59	65	69
Rubber	54	65	79	105	107	89	115	121	138	141	156
Petroleum	149	167	172	182	211	246	278	296	299	310	317
Food & Beverages	54	61	70	64	74	83	91	104	125	121	130
Textiles & Apparel	10	12	12	12	15	26	30	38	30	28	30
Other Manufacturing	53e	58e	64e	74e	93	105	118	119	105	65	54
ALL MANUFACTURING	3,536e	3,969e	4,529e	6,475e	7,569	8,272	9,479	10,341	10,714	11,230	12,354
ALL NONMANUFACTURING	94e	101e	111e	130e	162	117	139	168	194	234	276
ALL INDUSTRY	3,630	4,070	4,640	6,605	7,731	8,389	9,618	10,509	10,908	11,464	12,630

* - Includes Radio & TV
NA - Not Available
e - Estimated
SOURCE: National Science Foundation.

TABLE V (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of Dollars)

INDUSTRY	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Primary Metals	$195	$213	$232	$242	$251	$257	$275	$272	$277	$307	$358
Iron & Steel	116	128	139	135	135	136	149	144	147	163	181
Nonferrous Metals	79	85	93	107	115	121	126	128	130	145	177
Machinery	1,015	1,065	1,217	1,326	1,483	1,546	1,729	1,860	2,158	2,549	2,985
Electrical Machinery & Communications	2,972	3,200	3,626	3,867	4,083	4,347	4,220	4,389	4,680	4,902	5,011
Radio & TV Receiving Equipment	NA	NA	47	45	55	57	70	64	48	49	51
Commun. Equip. & Elect. Components	1,872	1,989	2,249	2,425	2,520	2,670	2,604	2,739	2,913	3,019	2,913
Other Electrical Equipment	1,100*	1,211*	1,330	1,397	1,508	1,620	1,546	1,586	1,719	1,834	2,047
Aerospace	5,078	5,148	5,526	5,669	5,765	5,878	5,219	4,881	4,950	5,052	5,278
Autos & Other Transp. Equipment	1,182	1,230	1,344	1,354	1,499	1,568	1,591	1,768	2,010	2,477	2,476
Fabricated Metal Products	148	145	154	163	183	182	207	242	253	291	313
Professional & Scientific Instrument	331	403	468	542	663	742	744	746	838	961	1,075
Scientific & Mechanical Measure	74	80	87	104	118	123	131	133	163	186	221
Optical, Surgical & Photo	257	323	381	438	545	619	613	612	675	775	854
Stone, Clay & Glass	109	112	117	136	142	159	167	164	183	199	217
Lumber & Furniture	12	11	12	12	20	18	52	53	64	71	84
Chemicals	1,284	1,356	1,407	1,507	1,589	1,660	1,773	1,832	1,932	2,116	2,450
Industrial Chemicals	865	908	918	966	981	1,007	1,031	1,009	1,031	1,119	1,299
Drugs & Medicines	234	267	308	343	398	444	485	549	607	698	807
Other Chemicals	185	181	181	198	210	209	257	274	294	299	344
Paper	77	94	117	128	144	188	178	187	189	194	237
Rubber	158	162	168	182	223	261	276	289	377	426	469
Petroleum	393	397	371	371	437	467	515	505	468	498	622
Food & Beverages	144	157	164	183	184	199	230	240	259	269	298
Textiles & Apparel	32	38	51	57	58	60	58	59	61	64	69
Other Manufacturing	65	71	77	90	101	121	128	131	146	158	177
ALL MANUFACTURING	13,193	13,801	15,051	15,826	16,826	17,653	17,362	17,816	18,845	20,534	22,119
ALL NONMANUFACTURING	319	384	497	559	603	655	705	704	707	715	768
ALL INDUSTRY	13,512	14,185	15,548	16,385	17,429	18,308	18,067	18,320	19,552	21,249	22,887

NA - Not Available
* - Includes Radio & TV

TABLE V (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of Dollars)

INDUSTRY	1975	1976	1977	1978	1979	1980	1981	1982
Primary Metals	$443	$506	$538	$560	$634	$728	$878	$835
Iron & Steel	215	256	284	314	375	443	487	510
Nonferrous Metals	228	250	254	246	259	285	391	325
Machinery	3,196	3,487	3,880	4,283	4,825	5,901	6,818	7,879
Electrical Machinery & Communications	5,105	5,636	5,886	6,507	7,824	9,175	10,329	11,925
Radio & TV Receiving Equipment	50	52	96	130	245	556	572	NA
Commun. Equip. & Elect. Components	2,934	3,202	3,495	3,901	4,804	5,571	6,331	NA
Other Electrical Equipment	2,121	2,382	2,295	2,476	2,775	3,048	3,426	NA
Aerospace	5,713	6,339	7,033	7,536	8,041	9,198	11,968	14,045
Autos & Other Transp. Equipment	2,430	2,872	3,478	4,010	4,668	5,117	4,986	4,962
Fabricated Metal Products	324	358	386	384	455	550	624	570
Professional & Scientific Instrument	1,173	1,331	1,571	1,998	2,505	3,029	3,614	4,047
Scientific & Mechanical Measures	266	325	452	670	950	1,352	1,499	NA
Optical, Surgical & Photo	907	1,007	1,119	1,328	1,555	1,677	2,115	NA
Stone, Clay & Glass	233	263	287	324	356	406	467	460
Lumber & Furniture	88	107	123	126	139	148	161	NA
Chemicals	2,727	3,017	3,202	3,580	4,038	4,636	5,625	6,588
Industrial Chemicals	1,391	1,524	1,668	1,798	1,962	2,197	2,802	NA
Drugs & Medicines	981	1,091	1,117	1,308	1,517	1,777	2,231	NA
Other Chemicals	354	401	417	474	559	662	592	NA
Paper	249	313	333	387	445	495	566	626
Rubber	467	502	491	493	577	656	678	888
Petroleum	693	767	918	1,060	1,262	1,552	1,958	2,248
Food & Beverages	335	355	415	472	528	620	641	752
Textiles & Apparel	70	82	83	89	101	115	130	129
Other Manufacturing	205	217	243	266	288	364	461	838
ALL MANUFACTURING	23,452	26,152	28,867	32,075	36,686	42,690	49,904	56,792
ALL NONMANUFACTURING	735	845	958	1,229	1,540	1,815	1,906	2,168
ALL INDUSTRY	24,187	26,997	29,825	33,304	38,226	44,505	51,810	58,960

TABLE VI

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL INVESTMENT
(Percent)

INDUSTRY	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Primary Metals	4.53%	8.12%	8.31%	6.12%	4.82%	8.91%	13.10%	10.66%	15.39%	15.55%	13.66%
Iron & Steel	4.47	7.46	6.97	5.34	4.71	8.08	10.37	7.61	11.40	12.76	12.05
Nonferrous Metals	4.65	9.62	12.17	7.95	5.00	10.63	19.43	23.44	27.24	21.76	16.74
Machinery	41.77	51.88	56.17	50.28	52.27	84.89	91.18	78.43	81.17	72.54	77.26
Electrical Machinery	151.30	177.25	189.04	207.67	243.78	339.48	328.03	248.24	236.48	266.57	280.98
Aerospace	552.67	666.00	558.70	577.84	559.57	931.79	1030.00	1033.53	1276.33	1010.50	1079.91
Autos & Other Transportation Equipment	36.67	30.00	36.91	31.85	45.32	73.16	64.15	55.25	63.24	63.23	56.48
Fabricated Metals	11.82	11.96	12.50	18.13	19.57	30.57	22.26	24.17	26.15	24.75	22.17
Instruments	161.82	139.29	110.00	105.26	131.05	196.00	162.63	137.08	129.13	118.85	97.93
Stone, Clay & Glass	10.00	10.23	7.19	6.67	8.85	13.64	11.41	11.28	12.57	13.33	14.29
Chemicals	26.52	36.67	44.50	44.21	40.99	60.00	76.15	61.64	68.81	74.37	72.03
Paper	7.07	7.33	6.27	4.50	4.32	7.37	7.54	7.27	9.52	10.48	9.86
Rubber	22.50	32.50	32.92	31.82	32.42	40.45	41.07	35.59	38.33	37.11	40.00
Petroleum	5.19	5.74	5.62	5.26	5.48	9.04	10.00	10.24	10.07	10.06	10.23
Food & Beverages	5.24	5.98	7.14	5.61	6.07	7.55	7.46	7.70	8.33	8.34	8.67
ALL MANUFACTURING	28.45	33.08	36.23	39.65	43.25	63.73	68.89	63.21	68.99	70.06	71.53
ALL NONMANUFACTURING	.44	.48	.46	.46	.53	.40	.45	.52	.60	.66	.77
ALL INDUSTRY	10.81	12.28	12.68	14.76	16.07	19.89	21.48	21.61	22.81	22.36	23.72

TABLE VI (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL INVESTMENT
(Percent)

INDUSTRY	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Primary Metals	9.75%	9.26%	8.53%	8.04%	8.04%	8.89%	9.79%	11.88%	13.58%	12.04%	8.97%
Iron & Steel	8.06	8.05	8.08	7.11	6.72	7.43	9.14	11.34	13.74	13.04	9.33
Nonferrous Metals	14.11	11.97	9.21	9.64	10.36	11.42	10.68	12.55	13.40	11.15	8.63
Machinery	63.04	47.54	41.82	43.91	51.14	42.59	45.74	59.05	66.81	64.21	57.07
Electrical Machinery	254.02	189.35	144.46	123.55	129.21	132.94	120.92	144.85	165.37	140.06	130.16
Aerospace	1238.54	971.32	472.31	453.52	468.70	455.66	593.07	774.76	727.94	580.69	349.54
Autos & Other Transportation Equipment	44.27	38.32	39.07	42.45	49.64	44.67	42.20	60.76	53.89	51.71	46.28
Fabricated Metals	17.41	16.86	13.51	12.64	13.46	13.58	16.97	20.17	17.69	16.08	16.13
Instruments	114.14	80.60	65.00	75.28	90.82	81.54	85.52	93.25	96.32	83.57	90.34
Stone, Clay & Glass	13.46	13.02	10.35	14.78	15.96	14.20	15.75	17.[illegible]	13.66	12.59	13.23
Chemicals	61.14	48.09	42.00	48.93	56.75	55.15	52.46	56.02	57.16	49.91	37.87
Paper	8.46	8.79	8.86	8.59	11.34	11.60	10.23	14.50	12.95	9.75	8.20
Rubber	33.62	27.46	25.85	27.16	23.23	24.39	30.00	36.58	36.60	27.48	29.87
Petroleum	11.20	10.23	8.28	7.67	8.81	8.88	9.98	9.69	9.77	10.64	8.51
Food & Beverages	8.23	8.40	7.77	8.93	8.36	7.21	6.93	7.16	7.90	7.43	7.39
ALL MANUFACTURING	62.14	54.31	47.98	49.07	52.03	48.67	46.94	52.43	53.20	48.46	41.57
ALL NONMANUFACTURING	.79	.85	.98	1.09	1.07	1.04	1.03	.94	.83	.75	.74
ALL INDUSTRY	21.91	20.14	18.91	19.64	19.70	18.40	17.11	16.88	16.26	15.43	14.58

TABLE VI (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL INVESTMENT
(Percent)

INDUSTRY	1975	1976	1977	1978	1979	1980	1981	1982	1983*
Primary Metals	8.54%	10.10%	11.52%	12.10%	11.57%	11.38%	13.24%	13.51%	22.01%
Iron & Steel	7.12	8.42	10.18	12.46	12.14	13.47	16.62	14.69	20.25
Nonferrous Metals	10.51	12.69	13.51	11.66	10.84	9.16	10.14	11.99	25.24
Machinery	64.44	63.06	58.88	59.40	45.87	50.91	66.13	61.12	62.07
Electrical Machinery	162.58	153.99	126.04	114.36	107.47	95.67	100.18	112.29	119.48
Aerospace	340.06	375.09	349.90	234.04	152.58	130.84	186.12	232.53	471.71
Autos & Other Transportation Equip.	57.31	61.11	59.76	55.54	56.24	56.48	59.78	56.23	63.80
Fabricated Metals	16.45	16.05	15.50	13.33	14.92	18.58	21.08	22.01	22.62
Instruments	110.66	117.79	116.37	125.66	142.33	132.85	53.78	72.21	174.84
Stone, Clay & Glass	14.04	14.06	12.81	10.45	9.04	10.63	14.87	12.62	22.65
Chemicals	35.74	37.16	39.34	42.32	37.46	36.79	41.36	67.27	56.24
Paper	8.36	10.06	9.25	9.70	8.02	7.28	8.42	10.49	12.32
Rubber	40.26	38.32	29.76	23.48	26.59	37.92	39.65	51.93	38.29
Petroleum	7.23	7.12	7.23	7.60	7.79	7.50	7.33	8.42	9.50
Food & Beverages	8.33	7.40	8.11	7.91	7.98	8.39	8.28	9.72	11.30
ALL MANUFACTURING	42.70	43.62	41.70	40.23	37.18	36.86	41.70	47.45	43.85
ALL NONMANUFACTURING	.72	.76	.74	.81	.90	1.01	.97	1.10	1.09
ALL INDUSTRY	15.34	15.75	15.06	14.40	14.13	15.05	16.37	18.63	20.61

*Other years do not include revised data. Completely revised table will be available shortly.

TABLE VII

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF SALES
(Percent)

INDUSTRY	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Primary Metals	.26%	.34%	.28%	.29%	.35%	.49%	.48%	.57%	.57%	.53%	.53%
Iron & Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nonferrous Metals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Machinery	1.35	1.60	1.88	1.91	2.26	2.95	2.89	2.80	2.60	2.51	2.44
Electrical Machinery	4.45	5.60	5.51	7.77	9.01	10.26	10.34	10.75	9.68	9.27	9.60
Aerospace	6.84	8.87	11.17	16.80	17.31	19.90	20.27	24.12	25.43	24.24	26.38
Autos & Other Transp. Equipment	1.99	2.61	2.09	2.90	2.75	4.31	3.54	3.34	3.44	3.52	3.43
Fabricated Metals	.34	.37	.40	.54	.60	.76	.58	.61	.58	.58	.64
Instruments	4.74	5.45	4.53	4.68	5.40	6.30	6.18	6.70	6.29	6.81	6.92
Stone, Clay & Glass	.56	.62	.53	.67	.81	.76	.71	.79	.79	.82	.81
Chemicals	1.99	2.14	2.08	2.82	3.01	3.50	3.44	3.76	4.12	4.08	3.97
Paper	.35	.38	.32	.34	.32	.38	.40	.44	.44	.45	.46
Rubber	1.08	1.41	1.39	1.87	1.86	1.27	1.43	1.49	1.70	1.57	1.62
Petroleum	1.18	1.28	1.22	1.17	1.29	1.57	1.71	1.76	1.78	1.80	1.76
Food & Beverages	.12	.13	.14	.13	.14	.16	.16	.18	.18	.18	.19
Textiles	.08	.10	.09	.09	.10	.16	.17	.22	.23	.21	.20
ALL MANUFACTURING	1.26	1.49	1.57	2.06	2.31	2.53	2.61	2.79	2.89	2.81	2.94

NA - Not Available

TABLE VII. (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF SALES
(Percent)

INDUSTRY	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Primary Metals	.50%	.48%	.48%	.54%	.52%	.53%	.58%	.53%	.47%	.42%	.37%
Iron & Steel	NA	NA	NA	NA	NA	.51	.59	.56	.51	.45	.36
Nonferrous Metals	NA	NA	NA	NA	NA	.57	.57	.61	.56	.48	.47
Machinery	2.87	2.69	2.59	2.69	2.90	2.76	3.06	3.32	3.28	3.28	3.23
Electrical Machinery	9.89	9.33	9.10	9.16	9.02	9.12	8.94	9.15	8.22	8.05	7.61
Aerospace	30.32	29.37	26.00	22.05	20.90	21.88	21.30	21.77	23.68	23.48	20.25
Autos & Other Transp. Equipment	2.85	2.43	2.62	2.90	2.66	2.67	3.16	2.64	2.73	2.86	2.99
Fabricated Metals	.51	.45	.42	.48	.41	.39	.45	.51	.47	.49	.46
Instruments	4.46	4.70	4.72	4.85	5.38	5.65	5.68	5.50	5.39	5.40	5.13
Stone, Clay & Glass	.83	.79	.79	.93	.89	.93	.98	.87	.85	.83	.82
Chemicals	3.82	3.69	3.52	3.64	3.54	3.50	3.65	3.60	3.37	3.32	2.92
Paper	.45	.51	.57	.61	.65	.77	.72	.73	.61	.59	.57
Rubber	1.54	1.42	1.33	1.37	1.49	1.60	1.71	1.63	1.80	1.75	1.68
Petroleum	2.14	2.08	1.82	1.68	1.88	1.91	2.07	1.87	1.63	1.43	1.06
Food & Beverages	.20	.21	.21	.22	.21	.21	.23	.23	.23	.20	.18
Textiles	.19	.19	.26	.29	.26	.26	.26	.25	.22	.20	.21
ALL MANUFACTURING	2.95	2.81	2.80	2.84	2.79	2.75	2.74	2.63	2.49	2.35	2.17

NA - Not Available

TABLE VII (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF SALES
(Percent)

INDUSTRY	1975	1976	1977	1978	1979	1980	1981	1982	1983
Primary Metals	.46%	.62%	.58%	.53%	.51%	.60%	.64%	.78%	
Iron & Steel	.51	.55	.56	.53	.56	.72	.70	1.08	1.36
Nonferrous Metals	.77	.68	.61	.53	.46	.48	.58	.54	.76
Machinery	3.33	3.30	3.17	2.99	2.90	3.27	3.35	4.36	4.70
Electrical Machinery	7.95	7.62	6.66	6.47	6.74	7.14	7.49	8.48	8.70
Aerospace	19.66	20.66	21.68	20.14	16.61	15.73	18.46	22.07	19.42
Autos & Other Transportation Equipment	2.77	2.60	2.58	2.65	3.05	4.00	3.61	3.89	3.52
Fabricated Metals	.47	.46	.43	.38	.30	.47	.51	.50	.53
Instruments	5.32	5.32	5.44	5.94	6.64	6.87	7.60	8.29	9.16
Stone, Clay & Glass	.86	.86	.81	.78	.78	.88	.95	1.05	1.28
Chemicals	3.04	2.90	2.71	2.76	2.73	2.87	3.21	3.81	3.82
Paper	.60	.65	.64	.68	.68	.68	.71	.79	.86
Rubber	1.71	1.58	1.24	1.14	1.23	1.39	1.46	1.77	1.87
Petroleum	1.00	.93	.94	1.02	.85	.78	.89	1.09	1.15
Food & Beverages	.19	.20	.22	.22	.22	.24	.24	.27	.31
Textiles	.21	.22	.20	.21	.22	.24	.25	.27	.36
ALL MANUFACTURING	2.26	2.21	2.13	2.11	2.12	2.31	2.50	2.97	2.97

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL INVESTMENT
(Percent)

INDUSTRY	1953	1954	1955	1956	1957	1958	1959
Iron & Steel	4.5	7.4	6.9	5.4	4.7	8.0	10.3
Nonferrous Metals	4.7	9.7	12.4	8.0	5.0	10.7	19.7
Non-Electrical Machinery	42.0	51.9	56.2	50.4	52.1	84.4	91.4
Electrical Machinery	152.7	178.1	190.0	207.0	242.1	342.4	328.0
Aerospace	552.7	689.0	564.8	574.0	556.5	931.8	1,021.5
Autos & Other Trans. Equipment	36.7	29.9	36.7	31.9	45.4	73.6	64.4
Fabricated Metals	11.7	12.1	12.6	18.2	19.6	30.7	22.1
Instruments	161.8	139.3	110.0	105.3	131.1	196.0	162.6
Stone,Clay & Glass	9.9	10.2	7.2	6.6	8.9	13.7	11.5
Chemicals	26.6	36.5	44.3	44.3	41.0	60.1	76.0
Paper & Pulp	7.1	7.3	6.2	4.5	4.3	7.3	7.6
Rubber & Plastic	22.3	32.1	33.3	32.1	32.2	40.0	41.4
Petroleum	5.2	5.7	5.6	5.3	5.5	9.0	10.0
Food & Beverage	5.3	6.0	7.2	5.6	6.1	7.5	7.5
ALL MANUFACTURING	28.4	33.1	36.2	39.6	43.2	63.7	68.9
ALL NONMANUFACTURING	0.5	0.6	0.6	0.6	0.7	0.6	0.6
ALL BUSINESS	12.1	14.1	15.0	17.4	19.1	24.8	26.8

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL INVESTMENT
(Percent)
(Continued)

INDUSTRY	1960	1961	1962	1963	1964	1965	1966
Iron & Steel	7.6	11.4	12.7	12.0	8.1	8.1	8.1
Nonferrous Metals	23.8	26.8	21.8	16.6	14.2	11.9	9.3
Non-Electrical Machinery	78.4	80.8	72.3	77.1	63.1	47.5	41.9
Electrical Machinery	218.2	237.0	265.9	281.0	252.9	189.3	144.3
Aerospace	1,018.6	1,255.4	1,023.3	1,077.0	1,231.0	975.9	472.3
Autos & Other Trans. Equipment	55.6	63.5	63.2	56.3	44.3	38.3	39.0
Fabricated Metals	24.1	25.9	24.6	22.3	17.5	16.8	13.5
Instruments	137.1	129.1	118.8	97.9	114.1	80.6	65.0
Stone,Clay & Glass	11.2	12.6	13.2	14.2	13.4	13.0	10.4
Chemicals	61.7	68.7	74.2	71.8	61.1	48.1	42.0
Paper & Pulp	7.3	9.5	10.5	9.8	8.5	8.8	8.8
Rubber & Plastic	35.1	38.3	37.6	40.3	33.8	27.7	25.8
Petroleum	10.2	10.1	10.1	10.2	11.2	10.2	8.3
Food & Beverage	7.7	8.3	8.3	8.7	8.2	8.4	7.8
ALL MANUFACTURING	63.2	69.0	70.1	71.5	62.2	54.3	48.0
ALL NONMANUFACTURING	0.7	0.9	0.9	1.0	1.1	1.1	1.3
ALL BUSINESS	26.6	28.5	28.1	28.9	26.4	23.8	22.1

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL EXPENDITURES
(Percent)
(Continued)

INDUSTRY	1967	1968	1968	1970	1971	1972	1973	1974
Iron & Steel	7.1	6.7	7.5	9.2	11.4	13.7	13.0	9.2
Nonferrous Metals	9.7	10.4	11.4	10.7	12.6	13.4	11.9	10.0
Non-Electrical Machinery	43.8	51.0	42.6	45.7	59.0	66.8	64.5	58.2
Electrical Machinery	123.5	129.0	133.0	120.9	144.7	165.5	140.7	131.8
Aerospace	453.5	470.6	454.8	593.1	777.8	722.6	633.5	435.3
Autos & Other Trans. Equipment	42.4	49.6	44.6	42.2	60.7	54.0	51.6	46.0
Fabricated Metals	12.6	13.5	13.6	17.0	20.1	17.7	16.1	16.2
Instruments	75.3	90.8	81.5	85.5	93.3	96.3	83.6	90.3
Stone,Clay & Glass	14.7	15.9	14.3	15.8	17.5	13.7	12.6	13.1
Chemicals	48.9	56.6	55.1	52.5	56.0	57.2	50.8	39.6
Paper & Pulp	8.6	11.3	11.6	10.3	14.6	13.0	9.7	8.2
Rubber & Plastic	27.4	23.4	24.3	30.1	36.5	36.6	27.3	29.1
Petroleum	7.7	8.8	8.9	10.0	9.7	9.8	10.8	8.8
Food & Beverage	8.9	8.3	7.2	6.9	7.2	7.9	7.2	7.0
ALL MANUFACTURING	49.1	52.0	48.7	46.9	53.0	53.2	48.5	42.1
ALL NONMANUFACTURING	1.4	1.4	1.3	1.3	1.2	1.0	0.9	0.9
ALL BUSINESS	22.5	22.8	21.4	19.7	19.7	18.9	17.7	16.4

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT
OF CAPITAL INVESTMENT
(Percent)
(Continued)

INDUSTRY	1975	1976	1977	1978	1979	1980	1981	1982
Iron & Steel	7.0	8.2	9.9	12.1	11.7	12.9	14.0	13.5
Nonferrous Metals	13.3	17.7	19.6	16.9	15.7	13.4	15.5	17.2
Non-Electrical Machinery	65.8	64.3	61.1	57.7	47.5	51.7	49.8	58.6
Electrical Machinery	165.6	156.2	127.5	110.5	103.7	93.9	97.7	108.3
Aerospace	480.1	621.5	616.9	427.0	297.8	257.8	356.2	411.9
Autos & Other Trans. Equipment	56.9	60.3	48.5	44.3	45.1	44.8	41.3	54.2
Fabricated Metals	16.6	16.3	15.7	13.1	14.1	16.5	17.2	18.5
Instruments	110.7	117.8	116.4	125.7	142.3	132.9	157.8	172.2
Stone,Clay & Glass	14.0	13.8	12.5	10.3	8.9	10.2	13.7	15.8
Chemicals	38.3	40.9	43.5	46.1	41.2	39.9	42.9	52.0
Paper & Pulp	8.5	10.5	9.6	10.2	8.5	7.6	9.3	11.2
Rubber & Plastic	38.9	36.6	27.8	21.2	23.4	32.3	31.5	41.1
Petroleum	7.6	7.7	7.8	8.1	8.3	7.9	7.5	8.5
Food & Beverage	7.6	6.6	7.3	7.2	7.3	7.6	6.8	8.6
ALL MANUFACTURING	43.7	44.7	42.8	40.8	38.2	38.0	39.4	47.1
ALL NONMANUFACTURING	0.8	0.8	0.8	0.9	1.0	1.1	1.0	1.1
ALL BUSINESS	17.0	17.0	16.1	15.3	15.0	15.7	16.4	19.0